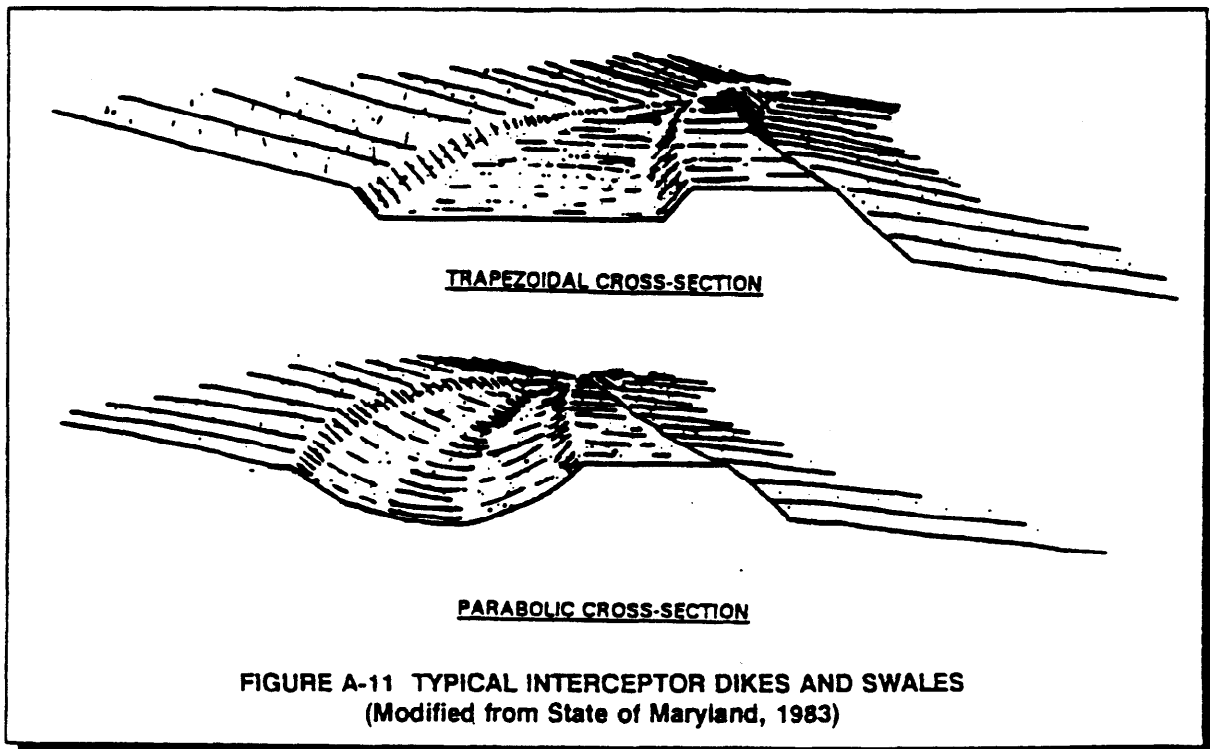


## Interceptor Dikes and Swales

### What Are They

Interceptor dikes (ridges of compacted soil) and swales (excavated depressions) are used to keep upslope runoff from crossing areas where there is a high risk of erosion. They reduce the amount and speed of flow and then guide it to a stabilized outfall (point of discharge) or sediment trapping area (see sections on Sediment Traps and Temporary Sediment Basins). Interceptor dikes and swales divert runoff using a combination of earth dike and vegetated swale. Runoff is channeled away from locations where there is a high risk of erosion by placing a diversion dike or swale at the top of a sloping disturbed area. Dikes and swales also collect overland flow, changing it into concentrated flows. Interceptor dikes and swales can be either temporary or permanent storm water control structures.



### When and Where to Use Them

Interceptor dikes and swales are generally built around the perimeter of a construction site before any major soil disturbing activity takes place. Temporary dikes or swales may also be used to protect existing buildings; areas, such as stockpiles; or other small areas that have not yet been fully stabilized. When constructed along the upslope perimeter of a disturbed or high-risk area (though not necessarily all the way around it), dikes or swales prevent runoff from uphill areas from crossing the unprotected slope. Temporary dikes or swales constructed on the down slope side of the disturbed or high-risk area will prevent runoff that contains sediment from leaving the site before sediment is removed. For short slopes, a dike or swale at the top of the slope reduces the

amount of runoff reaching the disturbed area. For longer slopes, several dikes or swales are placed across the slope at intervals. This practice reduces the amount of runoff that accumulates on the face of the slope and carries the runoff safely down the slope. In all cases, runoff is guided to a sediment trapping area or a stabilized outfall before release.

#### **What to Consider**

Temporary dikes and swales are used in areas of overland flow; if they remain in place longer than 15 days, they should be stabilized. Runoff channeled by a dike or swale should be directed to an adequate sediment trapping area or stabilized outfall. Care should be taken to provide enough slope for drainage but not too much slope to cause erosion due to high runoff flow speed. Temporary interceptor dikes and swales may remain in place as long as 12 to 18 months (with proper stabilization) or be rebuilt at the end of each day's activities. Dikes or swales should remain in place until the area they were built to protect is permanently stabilized. Interceptor dikes and swales can be permanent controls. However, permanent controls: should be designed to handle runoff after construction is complete; should be permanently stabilized; and should be inspected and maintained on a regular basis. Temporary and permanent control measures should be inspected once each week on a regular schedule and after every storm. Repairs necessary to the dike and flow channel should be made promptly.

<b>Advantages of Interceptor Dikes and Swales</b>
<ul style="list-style-type: none"><li>• Are simple and effective for channeling runoff away from areas subject to erosion</li><li>• Can handle flows from large drainage areas</li><li>• Are inexpensive because they use materials and equipment normally found onsite</li></ul>
<b>Disadvantages of Interceptor Dikes and Swales</b>
<ul style="list-style-type: none"><li>• If constructed improperly, can cause erosion and sediment transport since flows are concentrated</li><li>• May cause problems to vegetation growth if water flow is too fast</li><li>• Require additional maintenance, inspections, and repairs</li></ul>

## Temporary Stream Crossing

### What Is It

A temporary stream crossing is a bridge or culvert across a stream or watercourse for short-term use by construction vehicles or heavy equipment. Vehicles moving over unprotected stream banks will damage the bank, thereby releasing sediments and degrading the stream bank. A stream crossing provides a means for construction vehicles to cross streams or watercourses without moving sediment to streams, damaging the streambed or channel, or causing flooding.

### When and Where to Use It

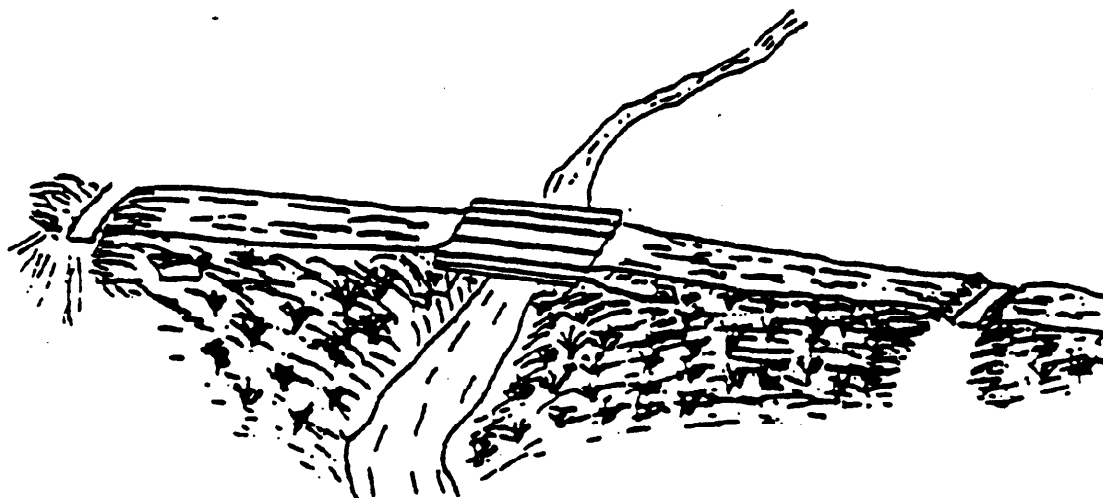
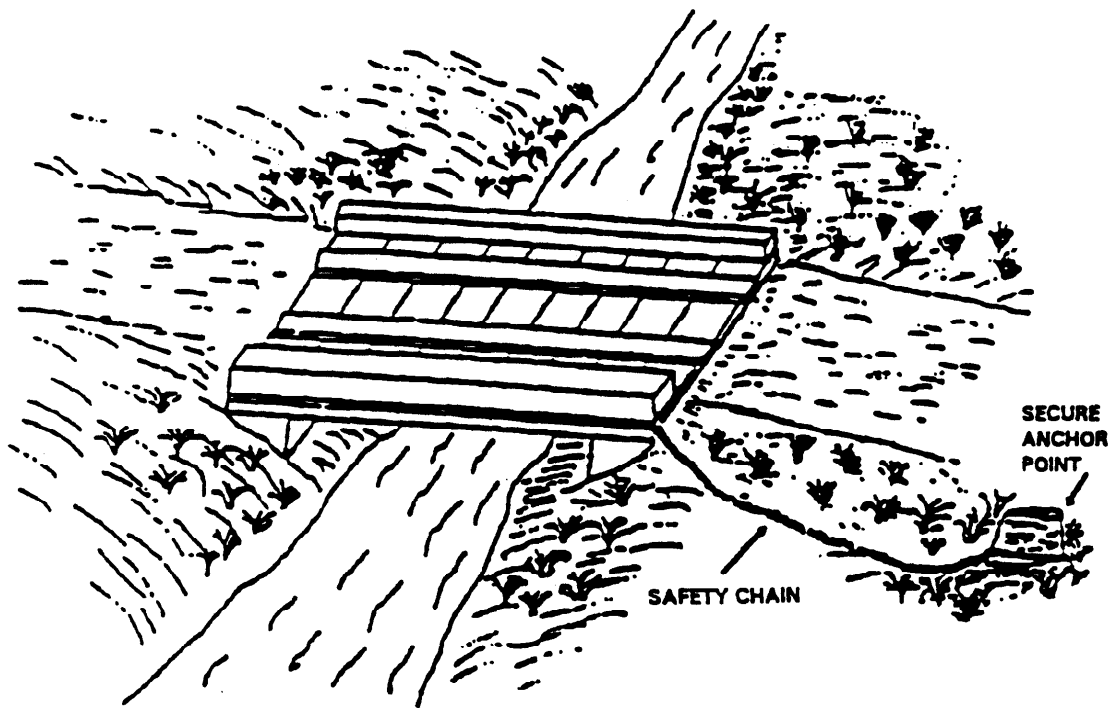
A temporary stream crossing is used when heavy equipment should be moved from one side of a stream channel to another, or where light-duty construction vehicles have to cross the stream channel frequently for a short period of time. Temporary stream crossings should be constructed only when it is necessary to cross a stream and a permanent crossing is not yet constructed.

- **Bridges**—Where available materials and designs are adequate to bear the expected loadings, bridges are preferred as a temporary stream crossing.
- **Culverts**—Culverts are the most common type of stream crossings and are relatively easy to construct. A pipe, which is to carry the flow, is laid into the channel and covered by gravel.

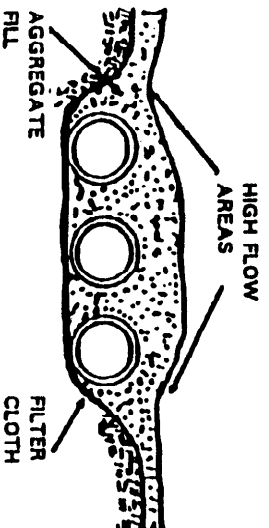
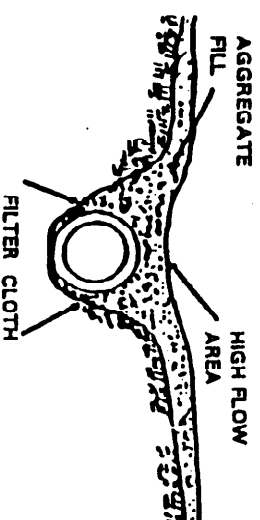
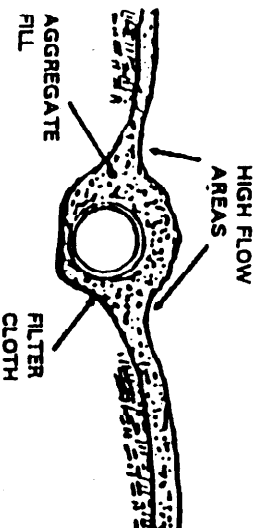
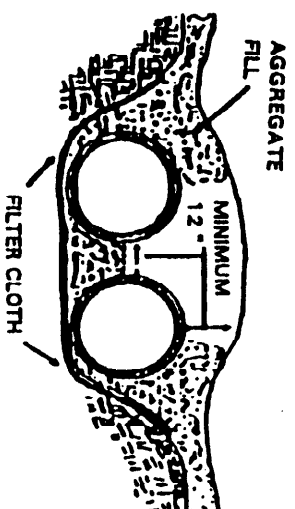
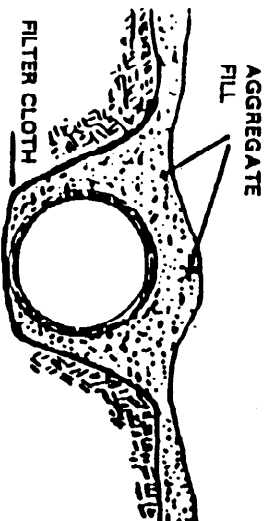
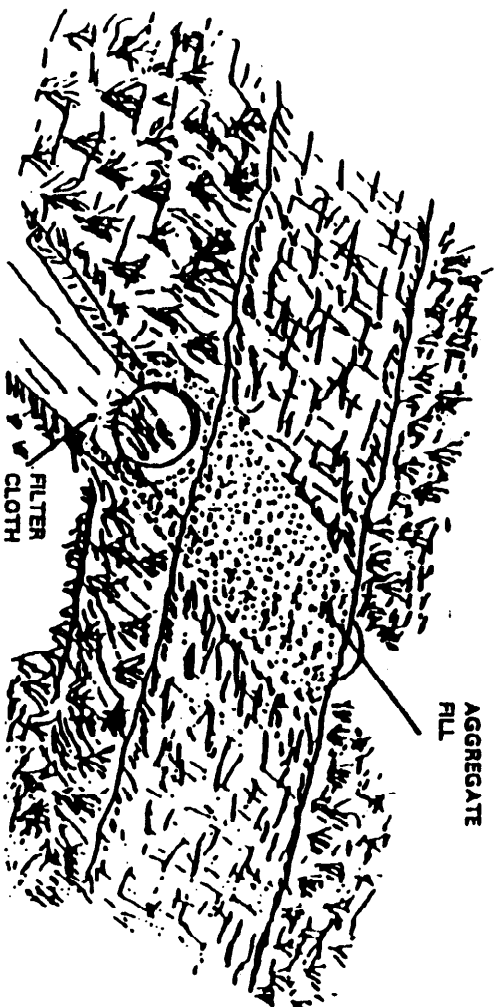
### What to Consider

When feasible, one should always attempt to minimize or eliminate the need to cross streams. Temporary stream crossings are a direct source of pollution; therefore, every effort should be made to use an alternate method (e.g., longer detour), when feasible. When it becomes necessary to cross a stream, a well planned approach will minimize the damage to the stream bank and reduce erosion. The design of temporary stream crossings requires knowledge of the design flows and other information; therefore, a professional engineer and specific State and local requirements should be consulted. State/local jurisdictions may require a separate permit for temporary stream crossings; contact them directly to learn about their exact requirements.

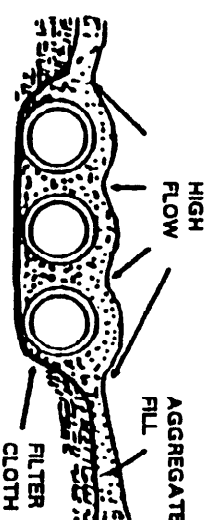
The specific loads and the stream conditions will dictate what type of stream crossing to employ. Bridges are the preferred method to cross a stream as they provide the least obstruction to flows and fish migration.



**FIGURE A-12 TEMPORARY ACCESS BRIDGE**  
(Modified from Maryland Department of the Environment, 1991)



MULTIPLE PIPES



MULTIPLE PIPES

FIGURE A-13 TEMPORARY ACCESS CULVERT  
(Modified from Maryland Department of the Environment, 1991)

Advantages of a Temporary Stream Crossing
<ul style="list-style-type: none"> <li>• Bridges provide the least obstruction to flow and fish migration and the construction material can be salvaged</li> <li>• Culverts are inexpensive and easily installed structures</li> </ul>
Disadvantages of a Temporary Stream Crossing
<ul style="list-style-type: none"> <li>• Bridges are expensive to design and install</li> <li>• Culverts cause greater disturbances during installation and removal</li> </ul>

## Temporary Storm Drain Diversion

### What Is It

A temporary storm drain is a pipe which redirects an existing storm drain system or outfall channel to discharge into a sediment trap or basin.

### When and Where to Use It

Use storm drain diversions to temporarily divert flow going to a permanent outfall. This diverted flow should be directed to a sediment-trapping device. A temporary storm drain diversion should remain in place as long as the area draining to the storm sewer remains disturbed. Another method is to delay completion of the permanent outfall and instead using temporary diversions to a sediment trapping device before discharge. Finally, a sediment trap or basin can be constructed below a permanent storm drain outfall. The basin would be designed to trap any sediment before final discharge.

### What to Consider

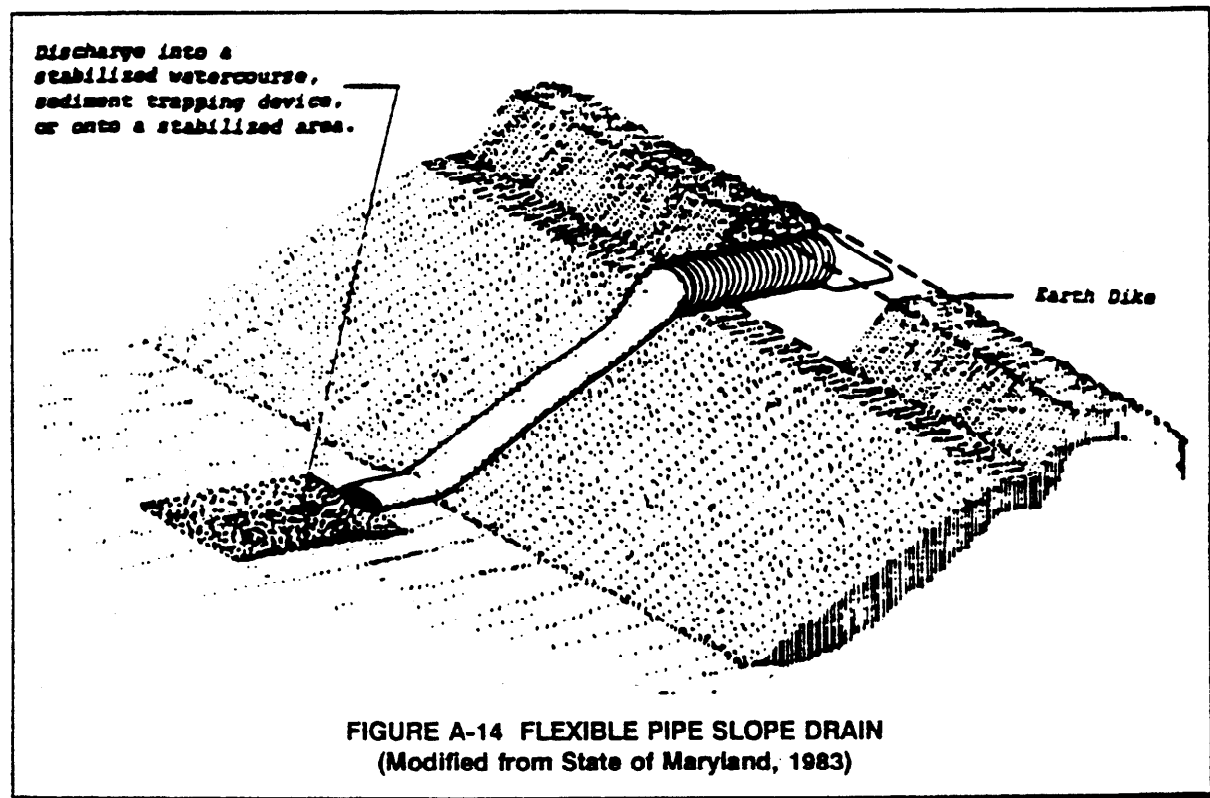
Since the existing storm draining systems will be modified, careful consideration to piping configuration and resulting impact of installing a temporary storm drain diversion should be given. The temporary diversions will also need to be moved, once the construction has ceased and it is necessary to restore the original storm drainage systems. Therefore, appropriate restoration measures such as flushing the storm drain prior to removal of the sediment trap or basin, stabilizing the outfall, restoration of grade areas, etc. should be taken. And finally, the State or local requirements should be consulted for detailed requirements.

Advantages of a Temporary Storm Drain Diversion
<ul style="list-style-type: none"><li>• Requires little maintenance once installed</li></ul>
Disadvantages of a Temporary Storm Drain Diversion
<ul style="list-style-type: none"><li>• Disturbs existing storm drainage patterns</li></ul>

## Pipe Slope Drains

### What Are They

Pipe slope drains reduce the risk of erosion by discharging runoff to stabilized areas. Made of flexible or rigid pipe, they carry concentrated runoff from the top to the bottom of a slope that has already been damaged by erosion or is at high risk for erosion. They are also used to drain saturated slopes that have the potential for soil slides. Pipe slope drains can be either temporary or permanent depending on the method of installation and material used.



### When and Where to Use Them

Pipe slope drains are used whenever it is necessary to convey water down a slope without causing erosion. They are especially effective before a slope has been stabilized or before permanent drainage structures are ready for use. Pipe slope drains may be used with other devices, including diversion dikes or swales, sediment traps, and level spreaders (used to spread out storm water runoff uniformly over the surface of the ground). Temporary pipe slope drains, usually flexible tubing or conduit, may be installed prior to the construction of permanent drainage structures. Permanent slope drains may be placed on or beneath the ground surface; pipes, sectional downdrains, paved chutes, or clay tiles may be used.



Paved chutes may be covered with a surface of concrete or other impenetrable material. Subsurface drains can be constructed of concrete, PVC, clay tile, corrugated metal, or other permanent material.

#### **What to Consider**

The drain design should be able to handle the volume of flow. The inlets and outlets of a pipe slope drain should be stabilized. This means that a flared end section should be used at the entrance of the pipe. The soil around the pipe entrance should be fully compacted. The soil at the discharge end of the pipe should be stabilized with riprap (a combination of large stones, cobbles, and boulders). The riprap should be placed along the bottom of a swale which leads to a sediment trapping structure or another stabilized area.

Pipe slope drains should be inspected on a regular schedule and after any major storm. Be sure that the inlet from the pipe is properly installed to prevent bypassing the inlet and undercutting the structure. If necessary, install a headwall, riprap, or sandbags around the inlet. Check the outlet point for erosion and check the pipe for breaks or clogs. Install outlet protection if needed and promptly clear breaks and clogs.

<b>Advantages of Pipe Slope Drains</b>
<ul style="list-style-type: none"><li>• Can reduce or eliminate erosion by transporting runoff down steep slopes or by draining saturated soils</li><li>• Are easy to install and require little maintenance</li></ul>
<b>Disadvantages of Pipe Slope Drains</b>
<ul style="list-style-type: none"><li>• Require that the area disturbed by the installation of the drain should be stabilized or it, too, will be subject to erosion</li><li>• May clog during a large storm</li></ul>

## PIPE SLOPE DRAIN

September 1992

### Design Criteria

- ▲ Pipe Slope Drains (PSD) are appropriate in the following general locations:
  - ▲ On cut or fill slopes before permanent storm water drainage structures have been installed.
  - ▲ Where earth dikes or other diversion measures have been used to concentrate flows.
  - ▲ On any slope where concentrated runoff crossing the face of the slope may cause gullies, channel erosion, or saturation of slide-prone soils.
  - ▲ As an outlet for a natural drainageway.
- ▲ The drainage area may be up to 10 acres; however, many jurisdictions consider 5 acres the recommended maximum.
- ▲ The PSD design should handle the peak runoff for the 10-year storm. Typical relationships between area and pipe diameter are shown in Table 2 below.

TABLE A-2 RELATIONSHIP BETWEEN AREA AND PIPE DIAMETER

Maximum Drainage Area (Acres)	Pipe Diameter (D) (Inches)
0.5	12
0.75	15
1.0	18

### Materials

- ▲ Pipe may be heavy duty flexible tubing designed for this purpose, e.g., nonperforated, corrugated plastic pipe, corrugated metal pipe, bituminous fiber pipe, or specially designed flexible tubing.
- ▲ A standard flared end section secured with a watertight fitting should be used for the inlet. A standard T-section fitting may also be used.
- ▲ Extension collars should be 12-inch long sections of corrugated pipe. All fittings must be watertight.

### Construction Specifications

- ▲ Place the pipe slope drain on undisturbed or well-compacted soil.
- ▲ Soil around and under the entrance section must be hand-tamped in 4-inch to 8-inch lifts to the top of the dike to prevent piping failure around the inlet.
- ▲ Place filter cloth under the inlet and extend 5 feet in front of the inlet and be keyed in 6-inches on all sides to prevent erosion. A 6-inch metal toe plate may also be used for this purpose.
- ▲ Ensure firm contact between the pipe and the soil at all points by backfilling around and under the pipe with stable soil material hand compacted in lifts of 4-inches to 8-inches.
- ▲ Securely stake the PSD to the slope using grommets provided for this purpose at intervals of 10 feet or less.
- ▲ Ensure that all slope drain sections are securely fastened together and have watertight fittings.

## PIPE SLOPE DRAIN

- ▲ Extend the pipe beyond the toe of the slope and discharge at a nonerosive velocity into a stabilized area (e.g., rock outlet protection may be used) or to a sedimentation trap or pond.
- ▲ The PSD should have a minimum slope of 3 percent or steeper.
- ▲ The height at the centerline of the earth dike should range from a minimum of 1.0 foot over the pipe to twice the diameter of the pipe measured from the invert of the pipe. It should also be at least 6 inches higher than the adjoining ridge on either side.
- ▲ At no point along the dike will the elevation of the top of the dike be less than 6 inches higher than the top of the pipe.
- ▲ Immediately stabilize all areas disturbed by installation or removal of the PSD.

### Maintenance

- ▲ Inspect regularly and after every storm. Make any necessary repairs.
- ▲ Check to see that water is not bypassing the inlet and undercutting the inlet or pipe. If necessary, install headwall or sandbags.
- ▲ Check for erosion at the outlet point and check the pipe for breaks or clogs. Install additional outlet protection if needed and immediately repair the breaks and clean any clogs.
- ▲ Do not allow construction traffic to cross the PSD and do not place any material on it.
- ▲ If a sediment trap has been provided, clean it out when the sediment level reaches 1/3 to 1/2 the design volume.
- ▲ The PSD should remain in place until the slope has been completely stabilized or up to 30 days after permanent slope stabilization.

### Cost

- ▲ Pipe slope drain costs are generally based upon the pipe type and size (generally, flexible PVC at \$5.00 per linear foot). Also adding to this cost are any expenses associated with inlet and outlet structures.

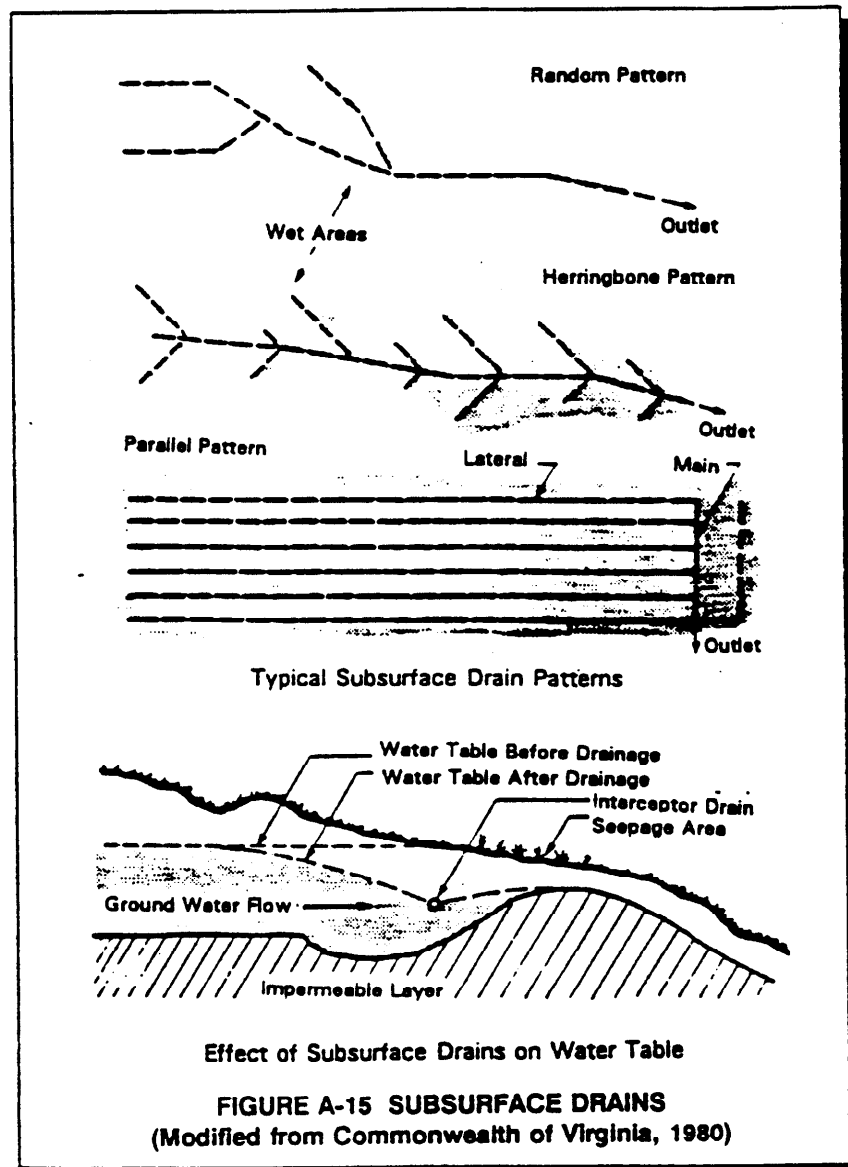
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- ▲ State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
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## Subsurface Drains

### What Are They

A subsurface drain is a perforated pipe or conduit placed beneath the surface of the ground at a designed depth and grade. It is used to drain an area by lowering the water table. A high water table can saturate soils and prevent the growth of certain types of vegetation. Saturated soils on slopes will sometimes "slip" down the hill. Installing subsurface drains can help prevent these problems.





### When and Where to Use Them

There are two types of subsurface drains: relief drains and interceptor drains. Relief drains are used to dewater an area where the water table is high. They may be placed in a gridiron, herringbone, or random pattern. Interceptor drains are used to remove water where sloping soils are excessively wet or subject to slippage. They are usually placed as single pipes instead of in patterns. Generally, subsurface drains are suitable only in areas where the soil is deep enough for proper installation. They are not recommended where they pass under heavy vehicle crossings.

### What to Consider

Drains should be placed so that tree roots will not interfere with drainage pipes. The drain design should be adequate to handle the volume of flow. Areas disturbed by the installation of a drain should be stabilized or they, too, will be subject to erosion. The soil layer must be deep enough to allow proper installation.

Backfill immediately after the pipe is placed. Material used for backfill should be open granular soil that is highly permeable. The outlet should be stabilized and should direct sediment-laden storm water runoff to a sediment trapping structure or another stabilized area.

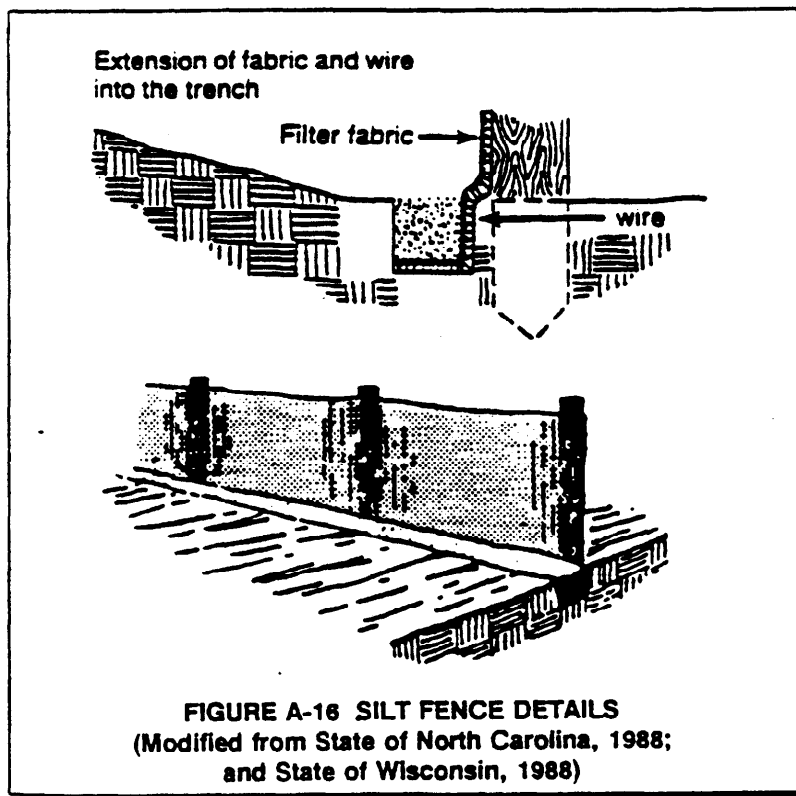
Inspect subsurface drains on a regular schedule and check for evidence of pipe breaks or clogging by sediment, debris, or tree roots. Remove blockage immediately, replace any broken sections, and restabilize the surface. If the blockage is from tree roots, it may be necessary to relocate the drain. Check inlets and outlets for sediment or debris. Remove and dispose of these materials properly.

Advantages of Subsurface Drains
<ul style="list-style-type: none"><li>• Provide an effective method for stabilizing wet sloping soils</li><li>• Are an effective way to lower the water table</li></ul>
Disadvantages of Subsurface Drains
<ul style="list-style-type: none"><li>• May be pierced and clogged by tree roots</li><li>• Should not be installed under heavy vehicle crossings</li><li>• Cost more than surface drains because of the expenses of excavation for installation</li></ul>

## Silt Fence

### What Is It

A silt fence, also called a "filter fence," is a temporary measure for sedimentation control. It usually consists of posts with filter fabric stretched across the posts and sometimes with a wire support fence. The lower edge of the fence is vertically trenched and covered by backfill. A silt fence is used in small drainage areas to detain sediment. These fences are most effective where there is overland flow (runoff that flows over the surface of the ground as a thin, even layer) or in minor swales or drainageways. They prevent sediment from entering receiving waters. Silt fences are also used to catch wind blown sand and to create an anchor for sand dune creation. Aside from the traditional wooden post and filter fabric method, there are several variations of silt fence installation including silt fence which can be purchased with pockets pre sewn to accept use of steel fence posts.



### When and Where to Use It

A silt fence should be installed prior to major soil disturbance in the drainage area. The fence should be placed across the bottom of a slope along a line of uniform elevation (perpendicular to the direction of flow). It can be used at the outer boundary of the work area. However, the fence does not have to surround the work area completely. In addition, a silt fence is effective where sheet and rill erosion may be a problem. Silt fences should not be constructed in streams or swales.

### **What to Consider**

A silt fence is not appropriate for controlling runoff from a large area. This type of fence can be more effective than a straw bale barrier if properly installed and maintained. It may be used in combination with other erosion and sediment practices.

The effective life span for a silt fence depends upon the material of construction and maintenance. The fence requires frequent inspection and prompt maintenance to maintain its effectiveness. Inspect the fence after each rainfall. Check for areas where runoff eroded a channel beneath the fence, or where the fence was caused to sag or collapse by runoff flowing over the top. Remove and properly dispose of sediment when it is one-third to one-half the height of the fence or after each storm.

<b>Advantages of a Silt Fence</b>
<ul style="list-style-type: none"><li>• Removes sediments and prevents downstream damage from sediment deposits</li><li>• Reduces the speed of runoff flow</li><li>• Minimal clearing and grubbing required for installation</li><li>• Inexpensive</li></ul>
<b>Disadvantages of a Silt Fence</b>
<ul style="list-style-type: none"><li>• May result in failure from improper choice of pore size in the filter fabric or improper installation</li><li>• Should not be used in streams</li><li>• Is only appropriate for small drainage areas with overland flow</li><li>• Frequent inspection and maintenance is necessary to ensure effectiveness</li></ul>

## SILT FENCE

September 1992

### Design Criteria

- ▲ Silt fences are appropriate at the following general locations:
  - ▲ Immediately upstream of the point(s) of runoff discharge from a site before flow becomes concentrated (maximum design flow rate should not exceed 0.5 cubic feet per second).
  - ▲ Below disturbed areas where runoff may occur in the form of overland flow.
- ▲ Ponding should not be allowed behind silt fences since they will collapse under high pressure; the design should provide sufficient outlets to prevent overtopping.
- ▲ The drainage area should not exceed 0.25 acre per 100 feet of fence length.
- ▲ For slopes between 50:1 and 5:1, the maximum allowable upstream flow path length to the fence is 100 feet; for slopes of 2:1 and steeper, the maximum is 20 feet.
- ▲ The maximum upslope grade perpendicular to the fence line should not exceed 1:1.
- ▲ Synthetic silt fences should be designed for 6 months of service; burlap is only acceptable for periods of up to 60 days.

### Materials

- ▲ Synthetic filter fabric should be a pervious sheet of polypropylene, nylon, polyester, or polyethylene yarn conforming to the requirements in Table 1 below.

TABLE A-3 SYNTHETIC FILTER FABRIC REQUIREMENTS

Physical Property	Requirements
Filtering Efficiency	75% - 85% (minimum)
Tensile Strength at 20% (maximum) Elongation	Standard Strength - 30 lb/linear inch (minimum)
	Extra Strength - 50 lb/linear inch (minimum)
Slurry Flow Rate	0.3 gal/ft <sup>2</sup> /min (minimum)

- ▲ Synthetic filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 to 120°F.
- ▲ Burlap of 10 ounces per square yard of fabric can also be used.
- ▲ The filter fabric should be purchased in a continuous roll to avoid joints.
- ▲ While not required, wire fencing may be used as a backing to reinforce standard strength filter fabric. The wire fence (14 gauge minimum) should be at 22-48 inches wide and should have a maximum mesh spacing of 6 inches.
- ▲ Posts should be 2-4 feet long and should be composed of either 2" x 2-4" pine (or equivalent) or 1.00 to 1.33 lb/linear ft steel. Steel posts should have projections for fastening wire and fabric to them.

### Construction Specifications

- ▲ The maximum height of the filter fence should range between 18 and 36 inches above the ground surface (depending on the amount of upslope ponding expected).



## SILT FENCE

- ▲ Posts should be spaced 8 to 10 feet apart when a wire mesh support fence is used and no more than 6 feet apart when extra strength filter fabric (without a wire fence) is used. The posts should extend 12 to 30 inches into the ground.
- ▲ A trench should be excavated 4 to 8 inches wide and 4 to 12 inches deep along the upslope side of the line of posts.
- ▲ If standard strength filter fabric is to be used, the optional wire mesh support fence may be fastened to the upslope side of the posts using 1 inch heavy duty wire staples, tie wires, or hog rings. Extend the wire mesh support to the bottom of the trench. The filter fabric should then be stapled or wired to the fence, and 8 to 20 inches of the fabric should extend into the trench (Figure 1).
- ▲ Extra strength filter fabric does not require a wire mesh support fence. Staple or wire the filter fabric directly to the posts and extend 8 to 20 inches of the fabric into the trench (Figure 1).
- ▲ Where joints in the fabric are required, the filter cloth should be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.
- ▲ Do not attach filter fabric to trees.
- ▲ Backfill the trench with compacted soil or 0.75 inch minimum diameter gravel placed over the filter fabric.

### Maintenance

- ▲ Inspect filter fences daily during periods of prolonged rainfall, immediately after each rainfall event, and weekly during periods of no rainfall. Make any required repairs immediately.
- ▲ Sediment must be removed when it reaches one-third to one-half the height of the filter fence. Take care to avoid damaging the fence during cleanout.
- ▲ Filter fences should not be removed until the upslope area has been permanently stabilized. Any sediment deposits remaining in place after the filter fence has been removed should be dressed to conform with the existing grade, prepared, and seeded.

### Cost

- ▲ Silt fence installation costs approximately \$6.00 per linear foot.

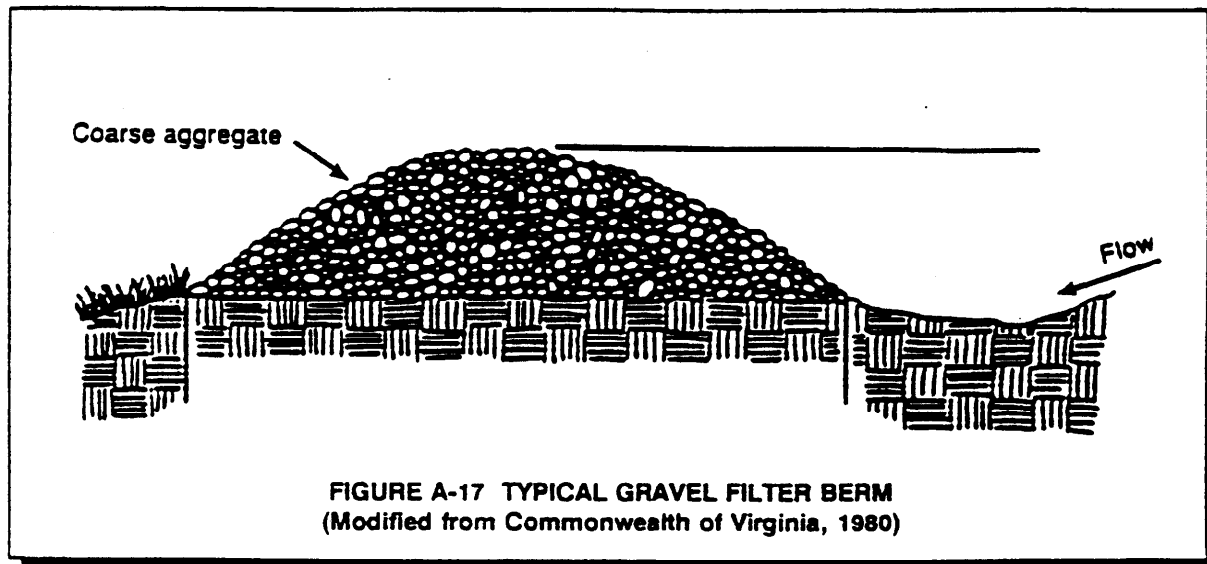
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- ▲ Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.

## Gravel or Stone Filter Berm

### What Is It

A gravel or stone filter berm is a temporary ridge constructed of loose gravel, stone, or crushed rock. It slows and filters flow, diverting it from an exposed traffic area. Diversions constructed of compacted soil may be used where there will be little or no construction traffic within the right-of-way. They are also used for directing runoff from the right-of-way to a stabilized outlet.



### When and Where to Use It

This method is appropriate where roads and other rights-of-way under construction should accommodate vehicular traffic. Berms are meant for use in areas with gentle slopes. They may also be used at traffic areas within the construction site.

### What to Consider

Berm material should be well graded gravel or crushed rock. The spacing of the berms will depend on the steepness of the slope: berms should be placed closer together as the slope increases. The diversion should be inspected regularly after each rainfall, or if breached by construction or other vehicles. All needed repairs should be performed immediately. Accumulated sediment should be removed and properly disposed of and the filter material replaced, as necessary.

<b>Advantages of a Gravel or Stone Filter Berm</b>
<ul style="list-style-type: none"><li>• Is a very efficient method of sediment control</li><li>• Reduces the speed of runoff flow</li></ul>
<b>Disadvantages of a Gravel or Stone Filter Berm</b>
<ul style="list-style-type: none"><li>• Is more expensive than methods that use onsite materials</li><li>• Has a very limited life span</li><li>• Can be difficult to maintain because of clogging from mud and soil on vehicle tires</li></ul>